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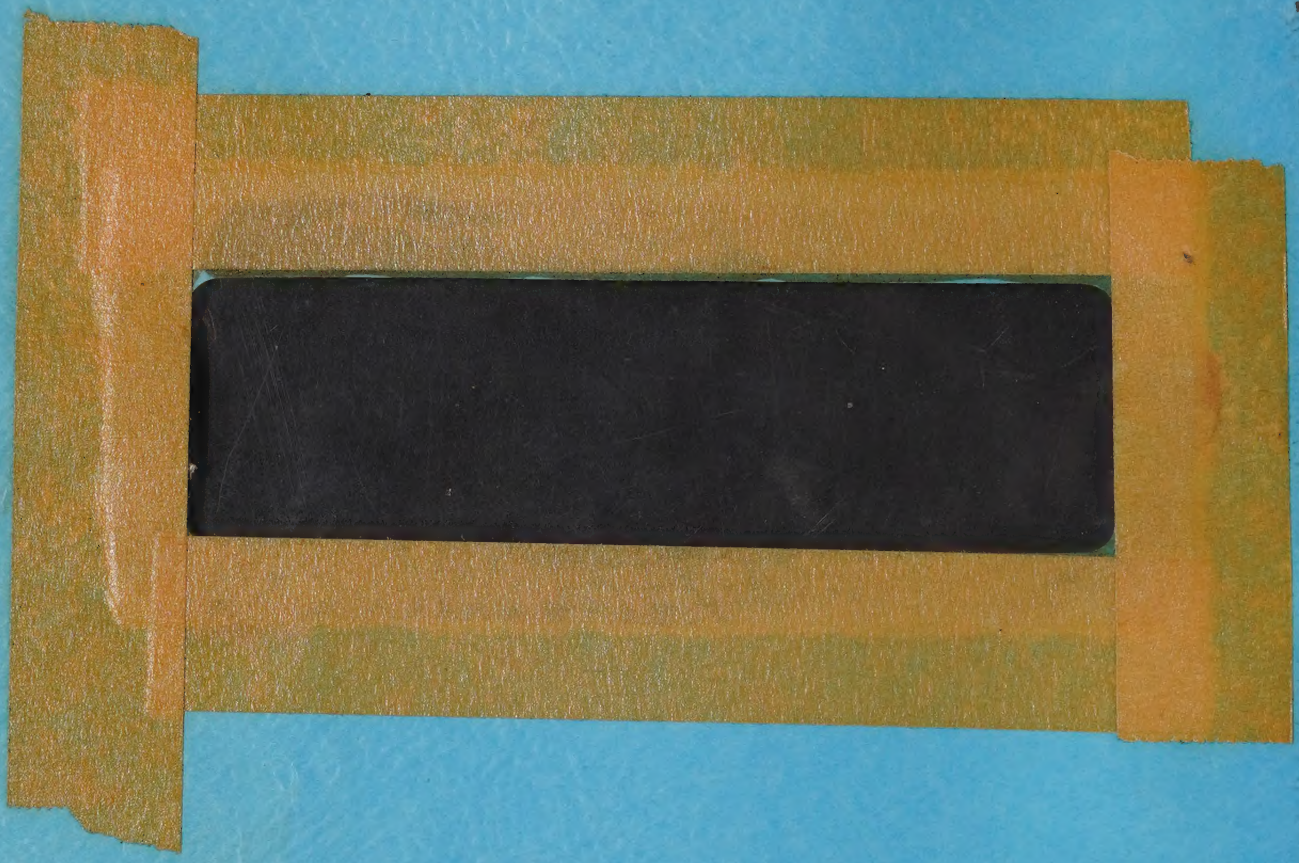
INSTRUMENT FLIGHT RESEARCH CORPORATION, INC.



Marker Beacon
Test Set
MB-100
Instruction Manual

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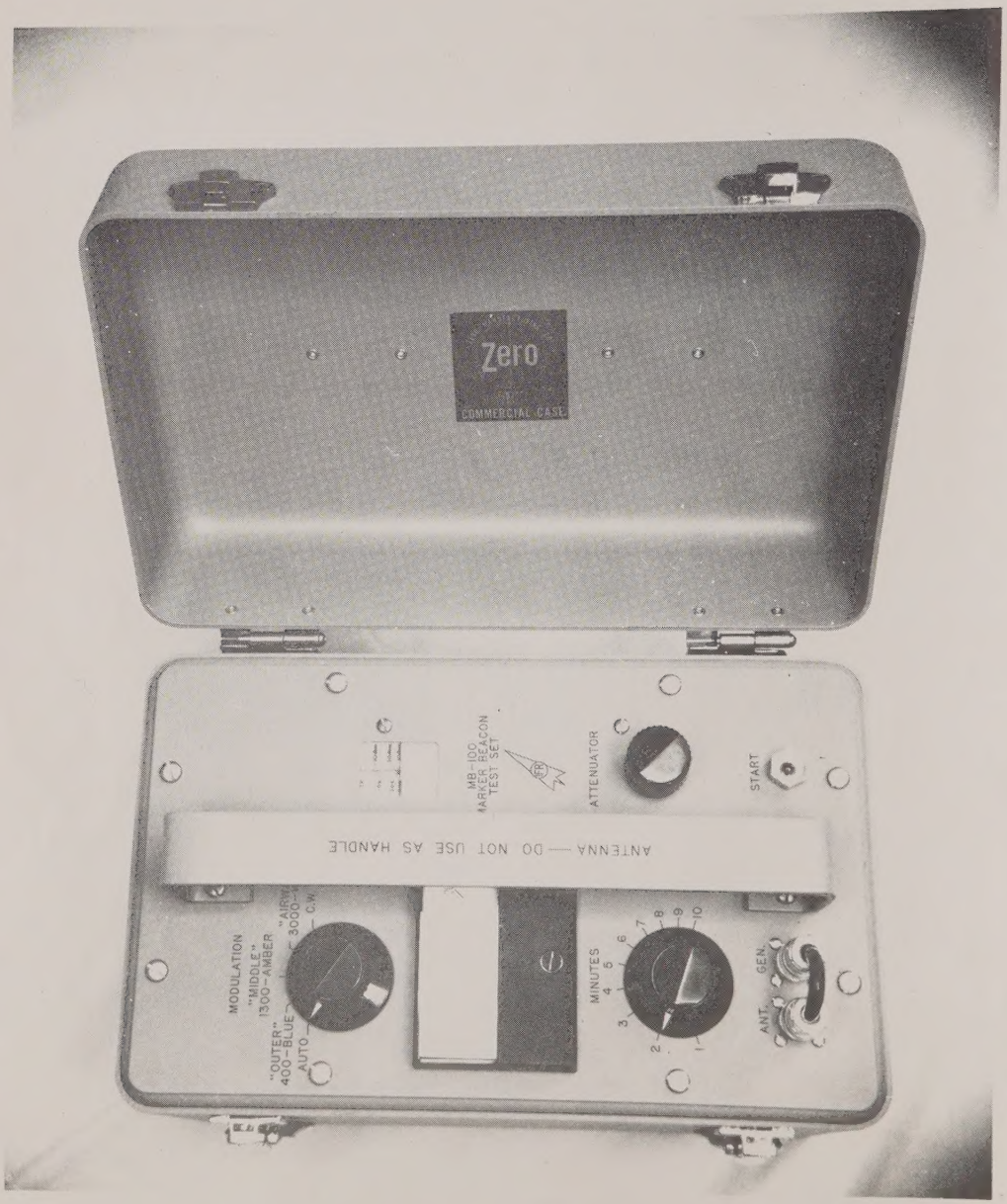

Zero
COMMERCIAL CASE
MB-100
MARKER BEACON
TEST SET
ATTENUATOR
START
ANTENNA — DO NOT USE AS HANDLE
MODULATION
"MIDDLE"
1300-AMBER
"OUTER"
400-BLUE
AUTO
MINUTES
ANT.
GEN.

Fig 1

I. GENERAL INFORMATION

1. Introduction

The MB-100, Marker Beacon Test Set is designed to provide the three standard marker signals for use in either shop or ramp checking of marker beacon receivers. The unit is portable and includes a self contained nickel cadmium battery pack and a self protecting charger to charge the battery from a 115 V. 60 cycle line by means of a separable three wire line cord.

2. Specifications - MB-100 Marker Beacon Test Set

Package	0.090TK Portable Aluminum carrying case with built-in antenna and slip-hinge cover.
Size	6.625" wide by 10.7" lg. by 8" high.
Weight	8.8 lbs. less cord.
Battery Power	Nickel Cadmium Power Pack. Over two hours continuous operation, when fully charged. Built in battery protecting charger.
R.F. Output	R.F. output (50 ohm source) to capacitive loaded panel antenna or to R.F. jack. Adjustable range 0.1V to 10 microvolts ± 2db. Self leveling circuit assures R.F. output stability. Monitor meter reads input to piston attenuator, and provides battery check.
Mode Switch	Permits selection of Automatic cycle, steady modulation by each marker tone, or CW operation.
Test Cycle - Automatic	Continuous cycling 4 sec. each beacon with standard tones, modulation depth, and keying speed.
Modulation Cycles	Outer Marker-400 cycle tone, 95% modulation on 316 m.s. followed by 105 m.s. carrier only, and repeat.

	Middle Marker-1300 cycle tone 95% modulation on 105 m.s., followed by 105 ms carrier only, followed by 316 ms tone, followed by 105 ms carrier only, and repeat. Airways-3000 cycle steady tone 95% modulation.
Start-Stop Switch	Push button start-stop switch will start test cycle for a preset time interval of 1 to 10 minutes. The cycle may be stopped at any time by pushing the button a second time. This will save battery life by preventing inadvertant battery run down.
Accuracy	Freq. - 75 mc ± 0.005% Tones - 400, 1300, 3000 cycles ±2% Modulation - 95 ±5% Output Level - Indicated ± 2db. Distortion - All tones less than 2%
Environment Range	Alt.- Temp. - -30 degrees C to +50 degrees C to 15,000 ft. Humidity - 90% to 100% Relative 48 hrs. Shock - 10G Vibration - 0.030" total excursion 5-55 cycles. 5G -55 to 500 cycles. 90 minutes each plane.

3. Equipment Supplied

The equipment supplied consists of the following items:

MB-100 Test Set
Coaxial jumper line
Three wire line cord
Nicad Battery
Instruction Book

II. OPERATION

1. General

The MB-100 is provided with four operating controls, see panel photo Fig. 1:

The start button is used to initiate a test cycle for a time determined by the timer. Recycling the start button will stop the test before the predetermined time has elapsed. In other words, the start button may also be used to stop the test signal.

The mode switch permits selection of five test cycle modes: Automatic test cycle mode - Auto-, or unkeyed modulation on each of the three marker tones, "Outer" 400-Blue, "Middle" 1300-Amber, "Airways" 3000-White,or CW operation. The Auto cycle will consist of approximately 4 seconds of each modulation cycle. This will be repeated for the duration of the timer setting of 1 to 10 minutes, or the test signal may be stopped at any time by recycling the start button.

The Timer Control, R-64 is used to set the total time duration of the test signal from 1 to 10 minutes. At the end of the preset time, the test set will shut itself off. This feature is provided to prevent inadvertent battery discharge. Excessive discharge of the battery will shorten battery life.

The attenuator control is used to set the desired output signal level. For ramp checking, the attenuator will be set near .05 volt to provide a standard signal at the aircraft marker antenna, if the distance between antennas is about 6 feet. For shop tests, the attenuator will normally be used in the range of 100 to 2000 microvolts. The attenuator reading is given in microvolts and dbm. The reading of the output attenuator will be within $\pm$ 2db of the actual signal provided the R.F. Monitor Meter reading falls within the green band from 14.6 to 16. If the Monitor Meter reading is below 14.6, the battery is nearly discharged.

2. Shop Use

In the shop, the MB-100 will be used for operational check of Marker Beacon receivers. When used for this purpose, the coaxial jumper interconnecting the "Antenna" and the "Gen" connectors should be disconnected from the "Gen" connector only (so it won't be lost) and the BNC output connector should be connected to the set being checked. The MB-100 will normally be connected to the power line so the battery will be kept charged all the time the unit is in the shop. Note, however that the charging circuit cannot furnish more than 18 ma and the set drain is 70 ma, so the set will be operating on the battery while being used in the shop.

3. Ramp Use

For ramp testing, the MB-100 will be disconnected from the line cord and will be used in its portable mode. In order to excite the tuned 75 mc. panel antenna, the coaxial jumper will be used to connect the "Antenna" jack to the "Gen" jack. The Test Set should be placed on the ramp under the aircraft marker antenna. The attenuator setting required to obtain a 2000 microvolt standard test signal at the aircraft antenna will depend upon the antenna spacings. It will be about 50,000 microvolts for a 6 foot spacing. The actual setting for a given aircraft installation should be determined by using a field strength meter connected

to the aircraft antenna, or, alternatively, a Marker Beacon receiver may be calibrated by measuring the AGC voltage and thus used to determine a standard signal.

The desired test cycle duration may be set on the timer and the test cycle initiated by a man on the ramp. The cycle can be set long enough so the same man, if desired, can then climb in the aircraft and observe the function of the Marker System.

4. Battery and Charger System

The MB-100 includes a current limiting and voltage cutoff charger which operates from a 115 V. 60 cycle line to keep the battery fully charged without over charging. When the battery is discharged, the maximum charging current will be about 0.018a, depending upon line voltage. As the battery reaches full charge, the voltage cutoff will gradually cut the current down to trickle charge at voltage set by the internal control, R-96. The normal range of battery voltage is about 17.2 to 14.2 volts. The R.F. Monitor will provide a reading equal to 10 times the battery voltage, i.e. a reading of 15 on the Monitor is also equal to 15 volts. 14.7 volts represent approximately $\frac{1}{2}$ charge on the battery. For maximum battery life, the battery should not be discharged frequently below 14.6 volts. The internal voltage cut off control is set at the factory to cut off the charge at 17.2 volts. This voltage is above that at which the battery will stabilize after receiving full charge and then a short discharge at the normal rate. Battery curves are shown in Fig. 2.

III. MAINTENANCE

1. Construction

An outline drawing of the MB-100 is shown on drawing IFR-2-278. The unit is constructed in a drawn 0.090 thick aluminum box with a slip-hinge cover. The lower half contains the battery and the charger system. The front panel mounts the controls and the remaining electronic circuitry.

The front panel and attached electronics is removed by unscrewing eight stainless steel 8-32 screws located around the edge of the panel. The line cord should be disconnected and care should be exercised when removing this assembly not to short A+ until the plug to the battery is removed.

All the tone and logic circuitry is located on an aluminum panel mounted on brackets attached to the front panel and the transmitter - attenuator assembly. The power section is disconnected from this panel by a plug. The electronic panel may be disconnected from the transmitter and controls by removing four screws and spacers and unplugging the R.F. section and the controls from three plugs on the electronics panel. The screws and spacers act as feet for the complete assembly when the front panel is removed from the case.

The R.F. assembly consists of a capacitive piston attenuator fed at one end from a capacitor plate connected to the tank circuit of the 75 mc modulated buffer-amplifier. A Tee section

low pass filter for suppressing harmonic radiation is located in the output lead of the attenuator. The R.F. crystal oscillator, operational modulator, buffer-amplifier, and envelope feedback detector are all located on a separately shielded chassis fastened to one end of the piston attenuator. The complete R.F. assembly may be removed from the front panel by removing the attenuator knob and four stainless steel 4-40 binding head screws from the panel. These screws are threaded into the aluminum end plates of the piston attenuator. If this unit is disassembled from the panel, reassembly will require careful alignment of the index on the attenuator window plastic with the tip end of the center line on the attenuator scale above the 100K microvolt marking to maintain R.F. calibration.

2. Adjustments

There are three internal adjustments in the MB-100 R-77, R-96, and line voltage taps.

R-77 is located in the R.F. sub assembly and is used as a fine adjustment of the R.F. amplifier level. R. F. leveling and envelope feedback are provided by means of a metal semiconductor hot carrier diode which will provide essentially constant level output over the full temperature range. Modulation percentage is controlled by a precision resistor bias divider for the emitter of the level controller, Q-12, and is adjusted at the factory by trimming the divider with shunt resistors. Tone frequencies are controlled by bridge T networks composed of precision resistors and mica capacitors and are adjusted at the factory by trimming resistors.

R-3 controls the voltage cutoff point of the battery charger. This is set at the factory as outlined in Section II-4.

Taps on the line transformer permit obtaining the proper maximum charge rate of 0.018a at line voltages of 101, 120, 138. Improper use of the taps will cause either too high a charge rate for maximum battery life or too low a charge rate for rapid recovery. The unit as shipped from the factory is set on the 120v. tap.

3. Service

The MB-100 is protected by a two year guarantee on service except battery change or service required due to mishandling. Field service should not be required except battery or fuse replacement. The fuse is only used as fire protection in case of a shorted rectifier or transformer.

The Battery is a GE catalogue number 42B902LD03.

The fuse is a 0.3a. slow blow with pigtail leads. Replacement may be made with larger ratings up to 3a.

The theory of operation of the Marker System is given in Section IV. The schematic diagram IFR2-279 provides typical voltages and waveforms at significant points in the system. All critical components are precision metal film resistors and silver mica capacitors, and the modulator transmitter, and tone oscillator all use operational amplifier techniques, so aging of components should not affect the performance of the unit. The

failures encountered will probably be catastrophic failures of transistors, diodes, or solid tantalum capacitors. Transistor or diode replacement should not require any readjustment, trimming, or retuning. This is true even in the oscillator and the transmitter. The following paragraphs provide alignment procedures for the critical circuits and sub assemblies:

3a. Oscillator and Transmitter Adjustment

The oscillator and final amplifier are both designed so that transistors may be changed without requiring retuning of the system, so alignment of the equipment at the factory should be valid for the life of the equipment.

The oscillator tank circuit is tuned to resonance by adjusting the spacing of the turns on the oscillator tank coil L-2. The turns are then cemented in place. This adjustment is made to obtain a dip in collector current of Q-24; due to the detected DC feedback, this is equivalent to tuning the oscillator for maximum output.

The final amplifier is then slug-tuned to obtain the greatest collector voltage dip; then it is tuned to the capacitive side of resonance to obtain the most undistorted modulation waveform at the collector supply of Q-24.

The oscillator is then retuned slightly on the capacity side to improve oscillator starting characteristics. This condition is obtained when the collector voltage of Q-24 rises to 7.8 volts, or thereabouts. Q-24 tank is retuned slightly if necessary to obtain the best modulation waveform.

The transmitter level control, R-77 is set so the CW output at the collector of Q-24 is 2.1V rms, when the attenuator is set at 100K. The stop and the scale of the attenuator are then set to obtain a maximum output of 100K microvolts at the appropriate scale location. The power output of 0.0002 watts should be measured with an accurate bolometer bridge power meter to make this setting, and the supply voltage should be set at 15.2 volts. The R.F. monitor meter should be trimmed to read 15.2 volts if required by changing the meter shunt resistor.

3b. Modulation Level

The modulation level should be set at about 95% at 15.2 supply voltage by trimming the emitter bias network of Q-12.

3c. Tone Networks

The tone networks are adjusted to within ± 2% of nominal frequency, if necessary, by trimming the resistors R31, 32, 36, 37, and 41, 42. In making these adjustments, the feedback lead from the collector of Q-11 is opened and a tone of the desired frequency is fed to the networks, the mode switch is set on the tone frequency to be adjusted, and the networks are trimmed with pots substituted to obtain a partial null of 1/40th of the input signal in phase with the input. The signal input should be kept low enough that the signal at the base of Q-9 is not more than 20mv. rms. Fixed resistors are then substituted for the pots. Each network is trimmed in a similar fashion.

3d. Keyer

The Keyer controls the on off timing of the keyed tones. For the Outer Marker this timing is 316m.s. tone followed by 105m.s. carrier only, and repeat. Aging of the solid tantalum coupling time constants may eventually require retrimming of the timing. If trimming is required, R-3 controls the 316m.s. and R-6, 7 control 105m.s.

For the Middle Marker the timing is 105m.s. carrier only followed by 316m.s. tone followed by 105m.s. carrier only followed by 105m.s. tone and repeat. In this mode, the Keying Alternator shunts R-3 with R-4 and 5 shortening alternate tones to 105m.s. Obviously R-3 must be trimmed first than R-4 and 5 may be trimmed to obtain 105m.s. on alternate tones.

3e. Ring Oscillator

The Ring Oscillator controls the timing of each tone cycle. Each time constant consisting of the 15 mfd solid tantalum coupling capacitor and the 390K base resistors provide approximately 4 seconds of each tone cycle and should not require adjustment or trimming unless the timing ages so far off nominal that it loses its utility.

3f. Charging Circuit

The charging circuit is adjusted by R-96 to obtain 17.2 volts output at a trickle rate of about 3.5 ma. This may be most easily accomplished by replacing the battery with a 5.1K resistor and adjusting R-96 to obtain 17.2 volts across the resistor.

3g. On Off Timer

Calibration of the On-Off timer may be accomplished by adjusting the knob at one minute and timing R-65 if required for 10 minutes.

4. Drawings

Outline Drawing	IFR 2-278
Replaceable Parts List	IFR 2-409
Parts Location - Charger	IFR 2-410
Parts Location - Transmitter Assembly	IFR 2-411
Parts Location - Electronics Panel	IFR 2-412
Schematic Diagram	IFR 2-279

IV. THEORY

1. Block Diagram

The Block Diagram of the MB-100 is shown in Fig. 3. The layout of this diagram is similar to the Schematic Diagram IFR-2-279A. System operation can be most easily understood if reference is made to both diagrams in the following description.

Briefly, the MB-100 is designed to provide marker signals which exactly duplicate the tones and tone keying of the ground environment. In the "Auto" mode, each marker signal is repeated sequentially so a complete test of a marker system may be performed. The mode switch may also be used to select continuous modulation on each of the three tones or CW operation. The output signal level is controlled by the variable attenuator.

2. Transmitter - Modulator

The transmitter employs a crystal controlled Colpitts oscillator, Q-23, and a collector modulated final amplifier, Q-24. Drive from the oscillator feeds the emitter of the final amplifier. The frequency control crystal is connected in series with the feedback path to the emitter. The oscillator will not run if the crystal is replaced with an equivalent capacity. The base of the final amplifier is bypassed to ground. A clamping diode CR38 is provided to swamp the final tank when the collector voltage is low. This aids in reaching the required high percentage of downward modulation.

The modulator is an operational amplifier whose output is connected to the collector of the final amplifier. The input stage of the operational amplifier Q20 and Q21 is a differential amplifier. The input modulating tones are connected to one side of the differential amplifier, and the other side is connected to the detected RF output of the Class C final amplifier. The detector CR37 uses a hot carrier diode whose linearity and detection efficiency are practically independent of temperature. The output stage of the modulation amplifier, Q22 is DC connected to the collector of the final, Q24. The modulation amplifier passes DC so that the modulator

controls the carrier level as well as providing over 43db of envelope feedback at 3000 cycles, 50db at 1300 cycles and over 56db at 400 cycles. This assures extremely linear modulation at the 95% modulation level used. The modulation level is set at the factory by trimming the tone oscillator levelling control stage, Q12, emitter bias which precisely controls the output tone level of the tone oscillator. 100% carrier is 6 volts peak to peak RF at the final output collector.

A piston attenuator using capacity coupling is connected between the final amplifier and output jack. A low-pass filter is built into the output of the attenuator to suppress harmonic radiation. The attenuator provides a source terminated signal of maximum 100,000 uV. The low-pass filter is designed to match 50 ohms at both ends.

The output jack of the attenuator is intended to be directly connected to the antenna jack by a jumper cable when the set is used as an MTF facility or to a marker receiver when the equipment is used as a signal generator.

A mechanical stop on the piston attenuator is adjusted at the factory so that the maximum output of the test set is 100,000 microvolts or 0.0002 watts into a 50 ohm load. The antenna used for ramp test purposes is connected to the front panel of the instrument. It is 9 inches long and 1 7/8 high above the panel. It is tuned to 75mc. by a 5-20pf trimmer at the end opposite the feed point and its impedance is adjusted to 50 ohms by a 150pf capacitor shunting the feed point. The antenna system looks like a pi network at 75mc.

3. Modulation Oscillator

The Modulation Oscillator and Level Control consists of an operational amplifier with positive and negative feedback. Negative feedback is through the tone network, which is adjusted to have an attenuation of 40:1 at zero phase angle. Positive feedback is connected through a diode attenuator system consisting of R-52, 54 and 57, and CR25. The level control transistor, Q-12 is normally biased off by the emitter bias network R55 and 56. When the tone level increases to the preset level, Q-12 starts to conduct, and its collector current flowing through CR-25 reduces the impedance of the diode and thus decreases the positive feedback. CR-24 is used in the base circuit of Q-12 to temperature compensate the base - emitter diode of Q-12; C-20 and C-21 are used to prevent oscillations of the operational amplifier.

The appropriate tone filter network is selected by the ring oscillator in the keyer system by means of the diode tone switches CR18-23. When the collector of Q-5 rises, for example, CR22 is cut off and CR-23 is turned on by current flowing from the collector of Q-11 through the 400 cycle tone network to the base of Q-9. Collectors of Q-6, 7 are down at that time turning on CR-18, 20 and turning off CR-19, 21.

4. Keyer System

The keyer system provides proper tone keying for the marker signal selected and sequencing of the marker signals.

The Ring Oscillator consists of Q-5, 6, 7. When the Mode Switch, S-1 is in the "Auto" mode, the collector of each transistor will be cut off in sequence for 4 seconds. The base time constant for each stage is 15mfd and 390K ohm. The tone filter switching by the collectors Q-5, 6, 7 is described in the section on the Modulation Oscillator.

Q-6 of the Ring Oscillator also enables the Keying Alternator when the 1300 cycle tone filter is enabled.

The Mode Switch, S-1, is connected to both the Ring Oscillator and the Keyer in such a manner that the appropriate tone filter and steady tone or no tone is selected.

The Keyer allows the tone produced by the Modulation Oscillator to be conducted to the Modulator through diodes CR-5, 6 when Q-1 is conducting. When Q-2 is conducting, CR-7 conducts and maintains the DC level at the cathode of CR-6 so that switching transients are cancelled out. R-13 is adjusted at assembly to achieve this balance. CR-7 disconnects R-11, 13 when the tone is on, so they do not reduce the tone level.

The timing of the Keyer is controlled by the base time constants of Q-1 and Q-2. The time constant in the base of Q-1 is adjusted to be 105m.s. for both "Outer" and "Middle" marker signals. The time constant in the base of Q-2 is either 105m.s. or 316m.s. This controls the on time of the tone. The on time is 316m.s. for the "Outer" marker. When the "Middle" marker is on, the Keying Alternator is enabled by cutting off CR-10 when the collector of Q-6 rises. Then the keying alternator changes state each time the collector of Q-2 cuts off. This action shortens the time constant at the base of Q-2 each time the collector of Q-3 conducts. When the Ring Counter is in the "Airway" mode, the collector of Q-7 rises and turns off Q-2 so that Q-1 remains on and the 3000 cycle tone will not be keyed.

5. Timer

Q-13 of the timer is connected in series with the battery and the A+ buss. When Q-13 is cut off all marker circuits are off except the charger. When the start button is pressed, Q-13 is turned on by current through CR-26 and C-27. R-59 will discharge C-27 between cycles. CR-27 prevents C-27 from being charged backwards. When the A+ buss rises, Q-13 is locked on by Q-14 and R-62. C-29 then charges slowly through R-68. As C-29 charges, the base of Q-16 follows in a negative direction. Q-16 will turn on at a voltage preset by the timer control R-64. When Q-16 turns on, Q-15 shorts the base of Q-14 to ground and turns off Q-13. As the A+ voltage collapses, Q-17 is turned on by the charge in C-30 and discharged C-29, so that the time

cycle will be the same duration each cycle. The low leakage diodes CR-29 and CR-30 prevent C-29 from being discharged by leakage current in Q-16 or Q-17.

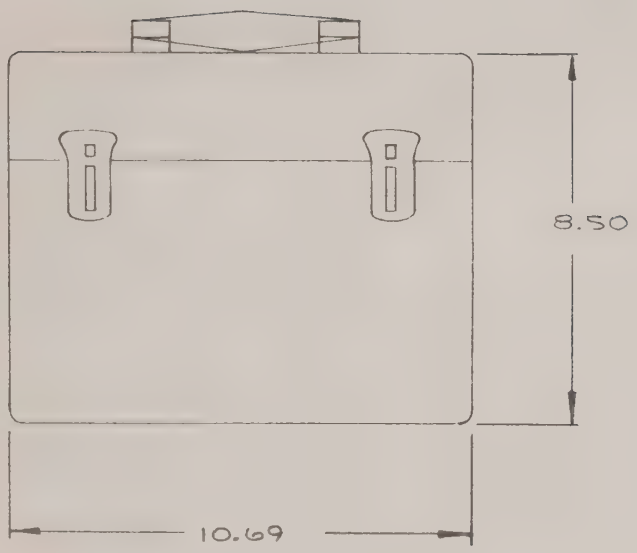
If S-2 is closed again during the timing period, the charge in C-28 will cut off Q-14 and stop the cycle.

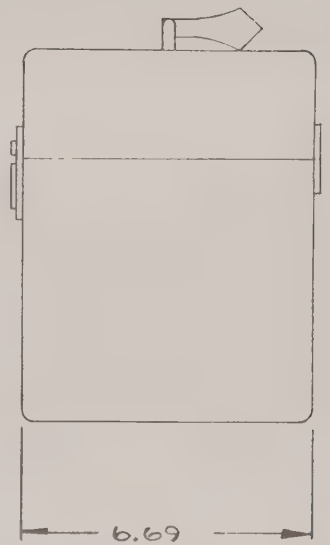
6. Charging Circuit

The charging Circuit is designed to permit the battery to be rapidly charged at the maximum recommended rate of 18ma. The constant current charge is controlled primarily by the power supply voltage and R-93, and will be maintained to within a few tenths of a volt of the maximum voltage set by R-96. The charge rate will then be rapidly cut back to a trickle which will maintain full battery charge and will not damage the battery. As the battery approaches within a few tenths of a volt of the final voltage, Q-19 is turned on and cuts down the current through Q-18. The diode CR-36 prevents the charging circuit from discharging the battery when the charger is disconnected from the line.

The transformer taps may be changed to obtain the maximum charge rate of 18ma. for the line voltage encountered where the equipment is used:

Pri Voltage	Pri Lead	Tap	D.C.
120	Black	Black-White	24.3
106	Black	Black-Green	24.3
90	Black	Black-Yellow	24.3
128	Black-Red	Black-White	24.3
112	Black-Red	Black-Green	24.3
93	Black-Red	Black-Yellow	24.3





WEIGHT: 8 1/2 LBS.
FINISH: LIGHT GRAY TEXTURED VINYL

INSTRUMENT FLIGHT RESEARCH CORP. INC.
WICHITA, KAN.

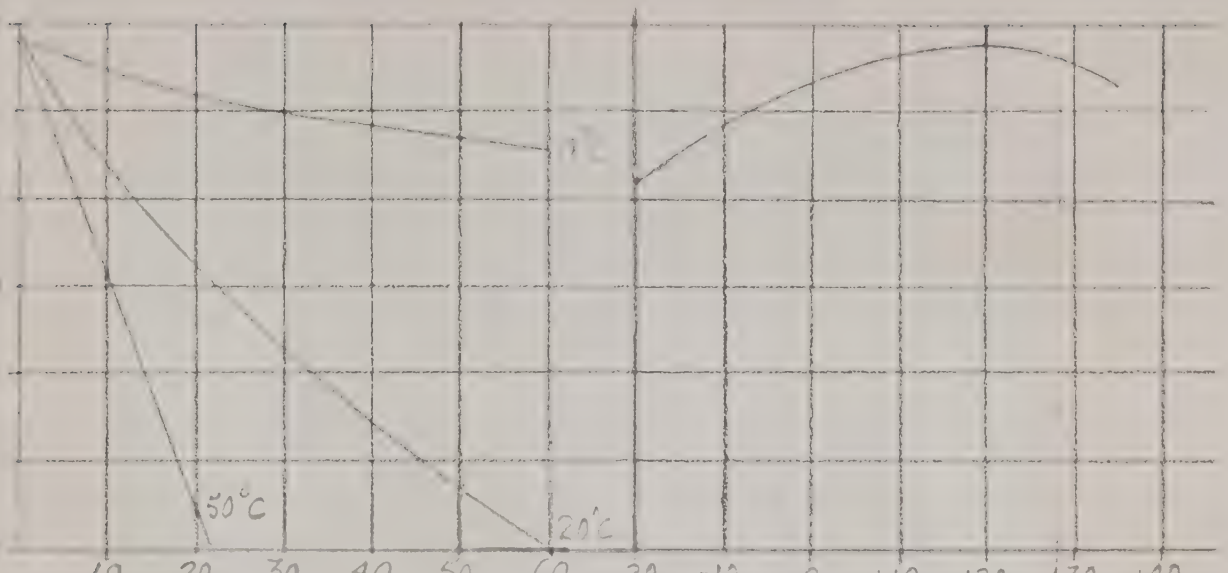
MARKER BEACON TEST SET OUTLINE

5-22-61 RR

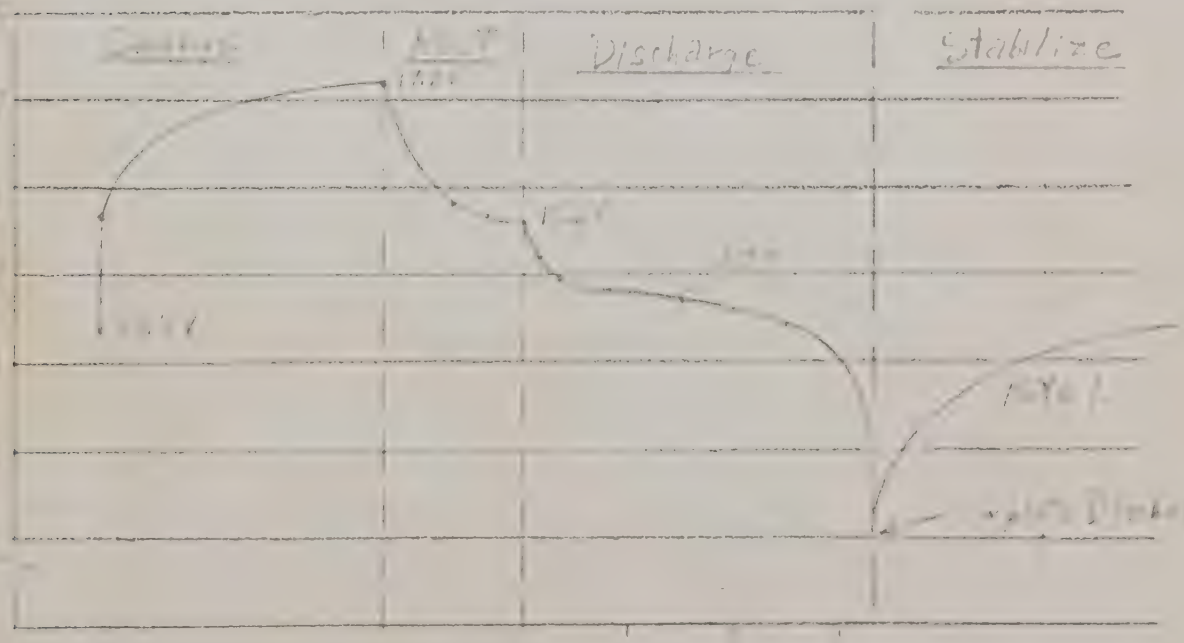
IFR-2-278A

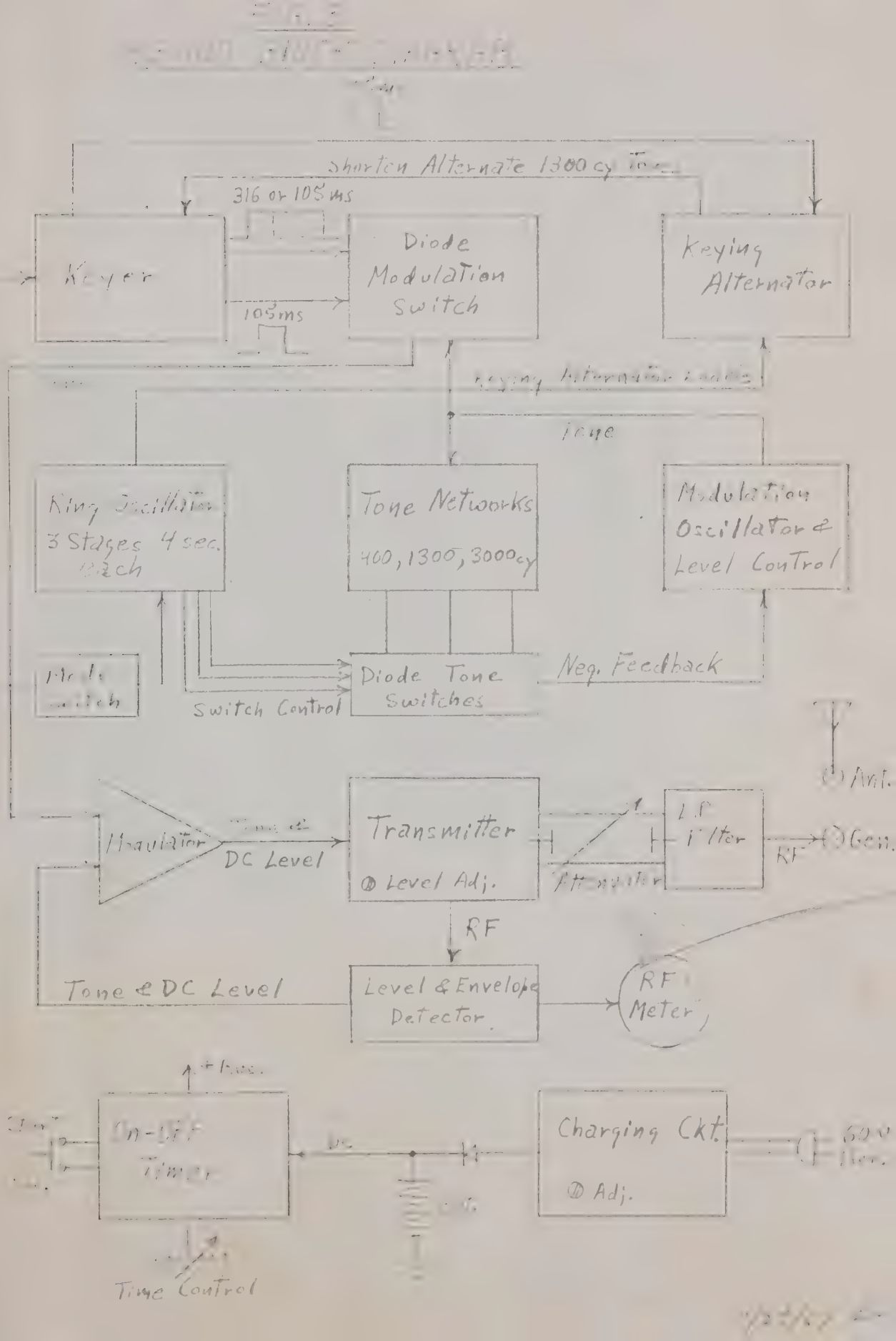
Fig. 2

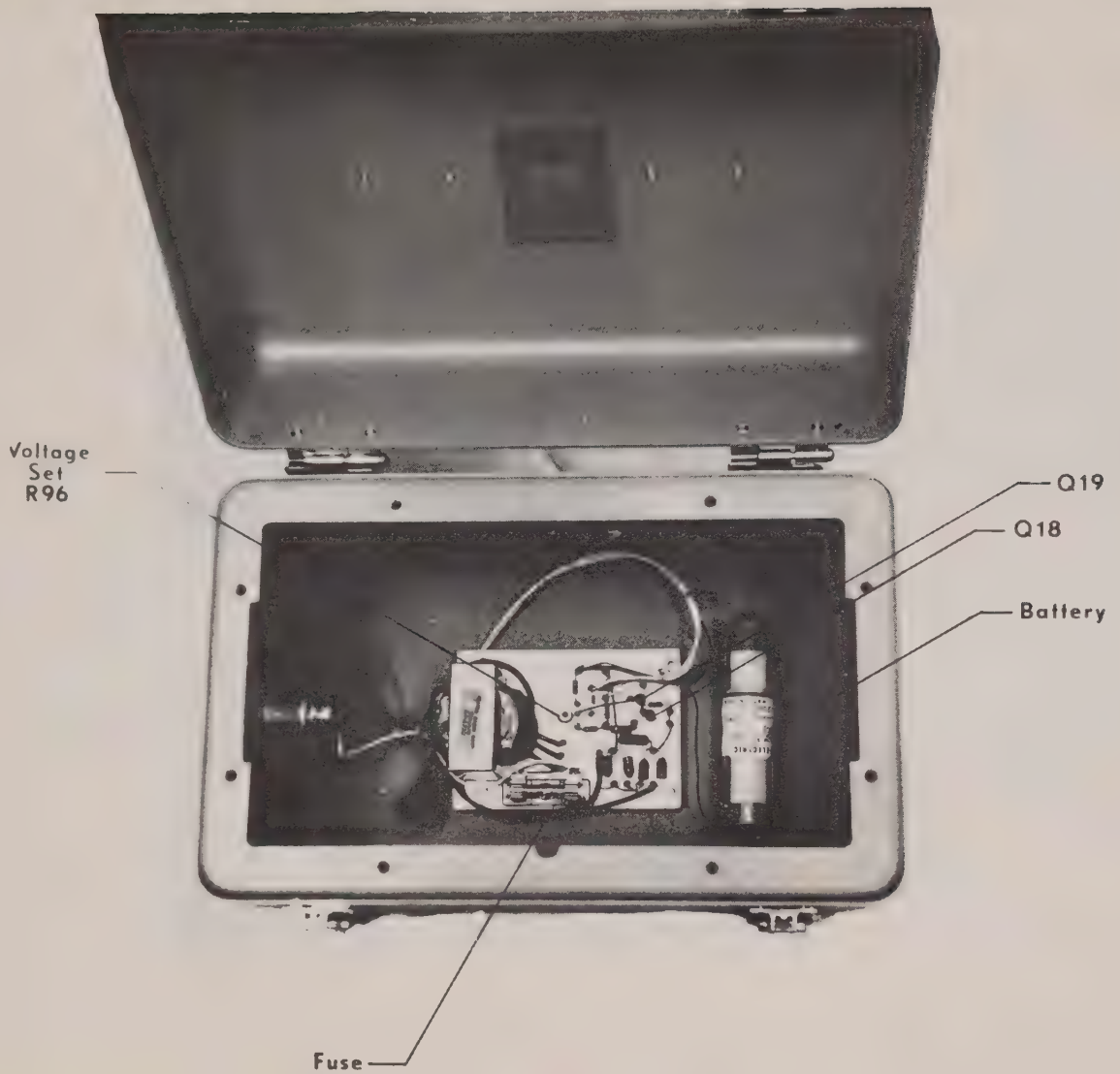
Battery Characteristics



Battery – G.E. 42B9021D03
12 Cells 0.18 ampere-hour
Discharge Rate – 0.07 a.




Shorten Alternate 1300 cy Tone
316 or 105 ms
Keyer
105 ms
Diode Modulation Switch
Keying Alternator
Keying Alternator Leads
Tone
King Oscillator 3 Stages 4 sec. 2ch
Tone Networks 400, 1300, 3000 cy
Modulation Oscillator & Level Control
Diode Tone Switches
Switch Control
Neg. Feedback
Ant.
Modulator
DC Level
Transmitter
Level Adj.
L.P. Filter
RF
Gen.
RF
Tone & DC Level
Level & Envelope Detector
RF Meter
+ bias
On-Off Timer
Charging Ckt.
Adj.
Time Control



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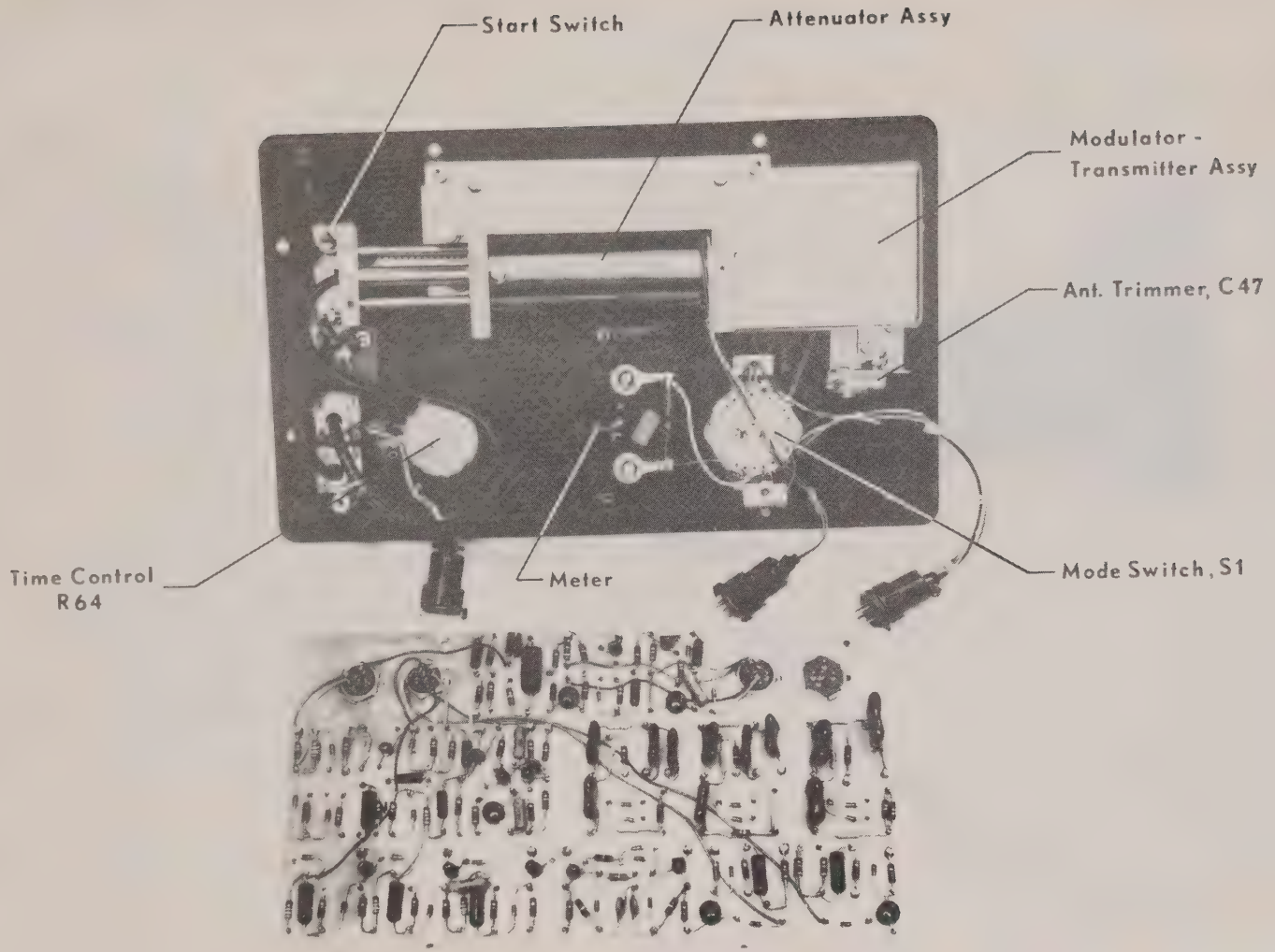
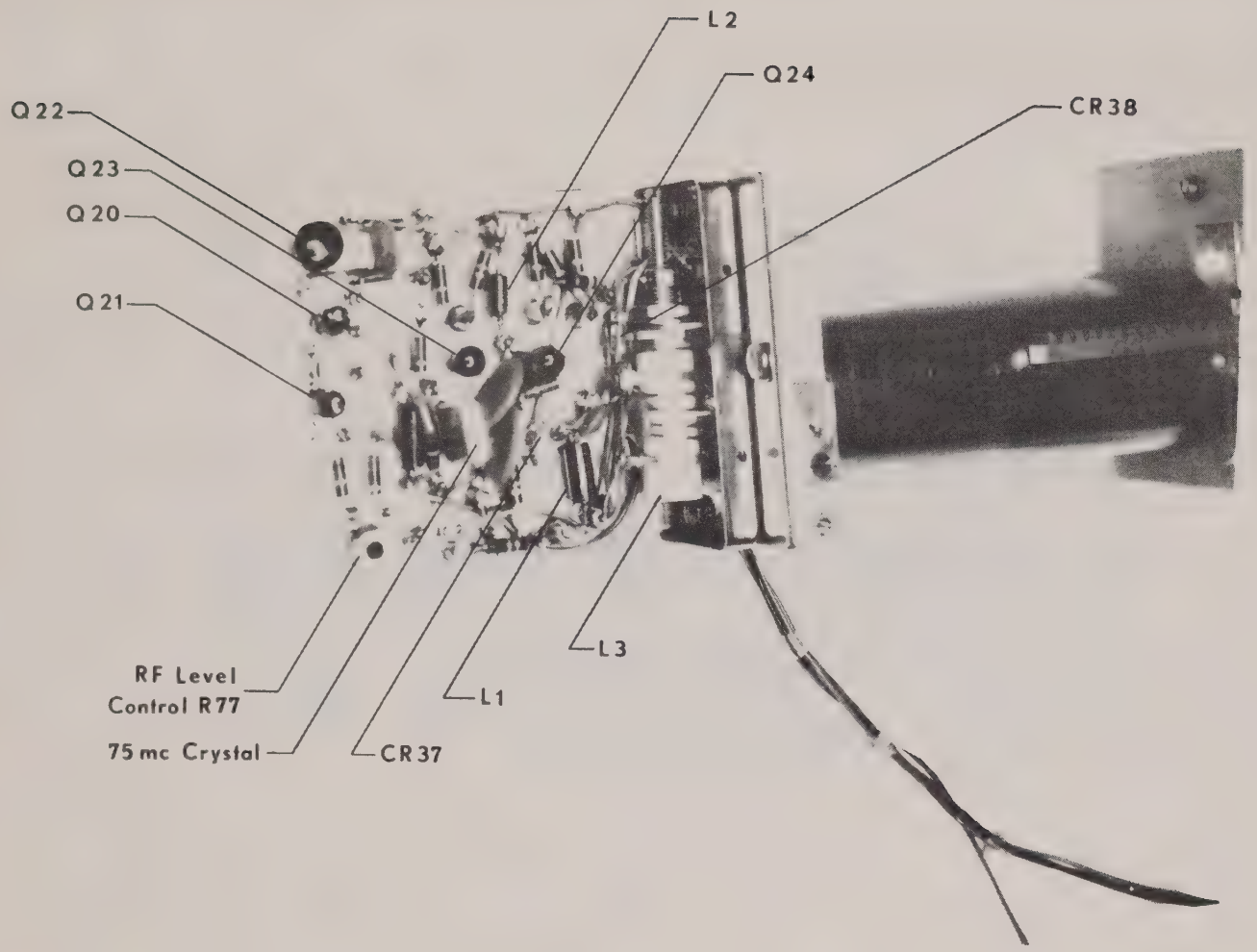
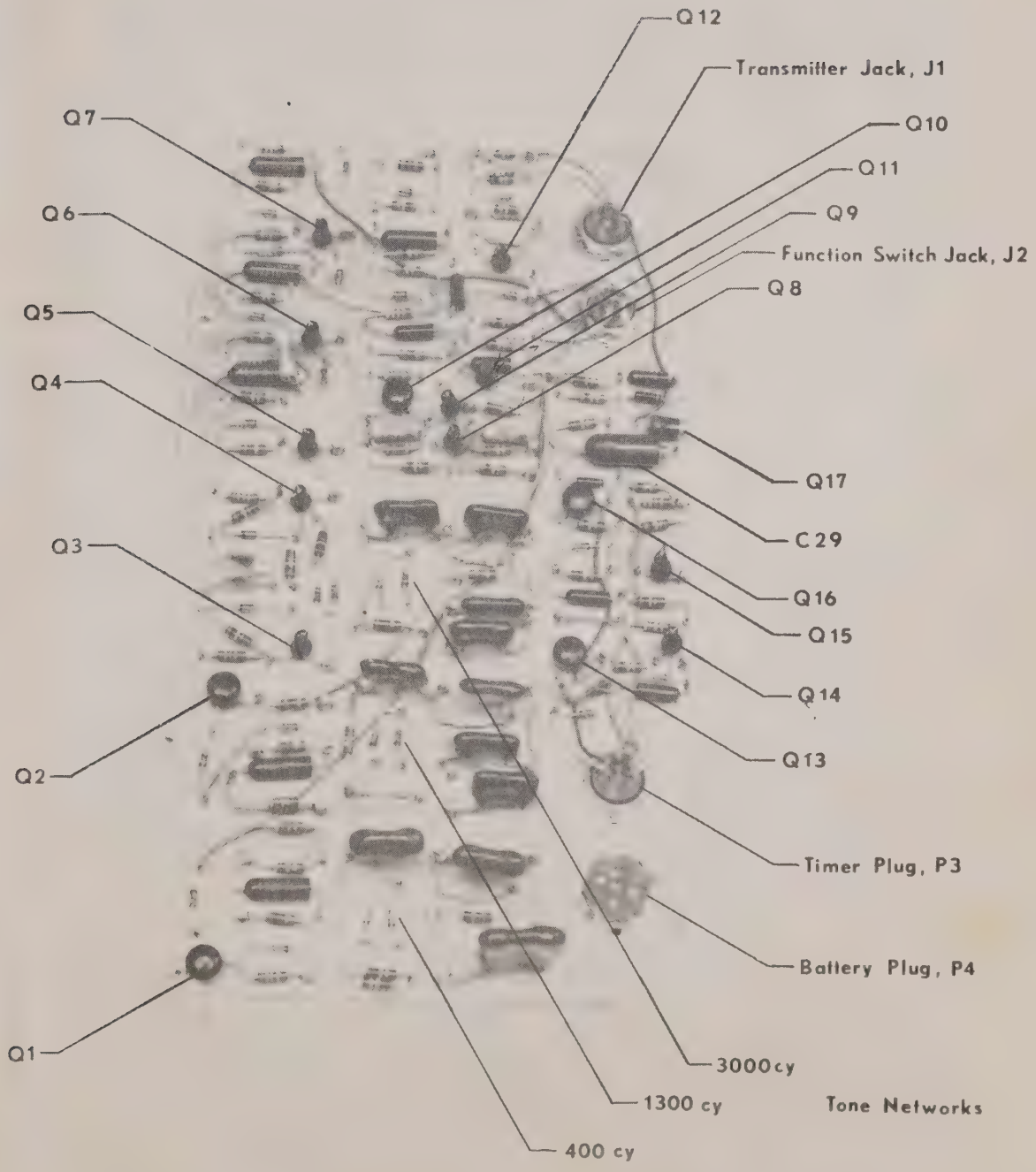

Start Switch
Attenuator Assy
Modulator -
Transmitter Assy
Ant. Trimmer, C47
Time Control
R64
Meter
Mode Switch, S1

Fig 2


L2
Q24
CR38
Q22
Q23
Q20
Q21
L3
RF Level
Control R77
L1
75 mc Crystal
CR37

IFR 2-411


Q12
Transmitter Jack, J1
Q7
Q10
Q11
Q6
Q9
Function Switch Jack, J2
Q5
Q8
Q4
Q17
C29
Q3
Q16
Q15
Q14
Q2
Q13
Timer Plug, P3
Battery Plug, P4
Q1
3000cy
1300 cy
Tone Networks
400 cy

PARTS LIST: MB-130 Marker Beacon Test Set SHEET 1 OF 4 REV:

Ref Des	Qty	Assy Brkdown 1	2	3	4	5	Part Number	Description	Quant. per Unit	Cost
1							B-1	15V. 0.18AH 12 cell GE. 42B902LD03	1	
2							C-1,2,5,7,8,24	15 mfd. 20V Solid Tant. Kemet K15C20	6	
3							C-3,4,53	1000 pf 200V Disc. Aerovox CK60AW102M	3	
4							C-6	0.01 mfd. 200V Mylar Sprague 10372	1	
5							C-9,10,11,12,13,14,15,16	1900 pf 500V Silver Mica C.D. CD19F182J	8	
6							C-17	7500 pf 500V Silver Mica C.D. CD[illegible]F752J	1	
7							C-18,19	3900 pf 500V Silver Mica C.D. CD19F392J	2	
8							C-20,21,26	560 pf 200V Mylar Sprague 56212	3	
9							C-22,23,25,28,32	1 mfd 35V Solid Tant. Kemet K1C35	5	
10							C-27	0.1 mfd 35V Solid Tant. Kemet K.1C35	1	
11							C-29	47 mfd 20V Solid Tant. Kemet K47C20	1	
12							C-30	4.7 mfd 35V Solid Tant. Kemet K4R7C35	1	
13							C-31	6.8 mfd 35V Solid Tant. Kemet K6R8C35	1	
14							C-37	1200 pf 500V Disc. Centralab CF122	1	
15							C-39,41,42,43,45	1000 pf 500V Ceramic Feedthrough Erie	10	
16							C-49,50,51,52			
17							C-36	100 pf 1000V Disc Sprague 5GAT10	1	
18							C-38	47 pf 1000V Disc Sprague 10TCC-Q47	1	
19							C-40,44	10 pf 1000V Disc Sprague 10TCC-Q10	1	
20							C-41	68 pf 1000V Disc Sprague 10TCC-Q68	1	
21							C-46	150 pf 1000V Disc Sprague 10TCC-T15	1	
22							C-47	5-20 pf 500V Ceramic Trimmer Centralab 822EN	1	
23							C-48	39 pf 1000V Tubular Ceramic Erie 391-000-X5P0-390K	1	
24										
25										
26							F-1	0.3A 3AG Littelfuse	1	
27										
28							J-1	5 Pin Winchester MS5LRN or equiv.	1	
29							P-1	5 Pin Winchester MSPLSH19C " "	1	
30										
31							J-2	7 Pin Winchester MS7LRN " "	1	
32							P-2	7 Pin Winchester MSPLSH19C " "	1	
33										

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PARTS LIST: SHEET 2 OF 4 REV:

Line	Size	Assy Brkdown 1	2	3	4	5	Part Number	Description	Quant. per Unit	Cost
1										
2							P-3	7 Pin Winchester M7PLRN or equiv.	1	
3							J-3	7 Pin Winchester M7SLSH19C " "	1	
4										
5							P-4	5 Pin Winchester MSPLRN " "	1	
6							J-4	5 Pin Winchester MSSLSH19C " "	1	
7										
8							L-1	100 μh JW Miller 9360-12 or equiv.	1	
9							L-2	Approx. 0.15 μh adj. at assy. IFR	1	
10							L-3	4t #20 spaced J.W. Miller 4400 Form	1	
11							L-4,5	0.1 μh Nytronics Wee Wee .10 Or equiv.	2	
12							M-1	0-200 μa meter calibrated 0-20, Green	1	
13								arc 14.5-16 G.E. 50-157-111 DRDR		
14										
15							Q-1,2,10,13,16,22	Fairchild 2N3638A	6	
16							Q-3,4,5,6,7,8,9,11,	G.E. 2N3415	16	
17							Q-12,14,15,17,18,19			
18							Q-20,21			
19							Q-23,24	Fairchild 2N3564	2	
20										
21										
22							R-1,9,11,12,14,19	6.8K 10% ¼w Comp. Ohmite	12	
23							R-21,24,27,47,73,			
24							R-78			
25										
26							R-2,8,10,50	1.5K 10% ¼w Comp. Ohmite	4	
27							R-3	47K 10% ¼w Comp. Ohmite	1	
28							R-4	15K 10% ¼w Comp. Ohmite	1	
29							R-5,7,31,32,36,37	Adjust at assy.	10	
30							R-41,42,99,13,101,106			
31							R-6,83	12K 10% ¼w Comp. Ohmite	2	
32										
33										

Instrument Flight Research Corporation, Inc., Wichita, Kansas | Dwg. No. IFR 2-409

PARTS LIST: SHEET 3 OF 4 REV:

Line	Size	Assy Brkdown 1	2	3	4	5	Part Number	Description	Quant. per Unit	Cost
1							R-15,16,17,18,44,45	100K 10% 1/4w Comp. Ohmite	10	
2							R-63,67,71,66			
3							R-20,23,26	390K 10% 1/4w Comp. Ohmite	3	
4							R-22,25,28,46,59.	22K 10% 1/4w Comp. Ohmite	11	
5							R-61,100,102,103.			
6							R-104, R-105			
7										
8							R29	32.2K 1% Metal Film Electra MC5F D	1	
9							R-30	22.1K " " " " " "	1	
10							R-33	16.5K " " " " " "	1	
11							R-34	71.5K " " " " " "	1	
12							R-35	63.4K " " " " " "	1	
13							R-38	38.3K " " " " " "	1	
14							R-39, 40	95.3K " " " " " "	2	
15							R-43	54.9K " " " " " "	1	
16										
17							R-48, 85, 88	470 ohm 10% 1/4w Comp. Ohmite	3	
18							R-49, 87, 90, 94	2.3K 10% 1/4w Comp. Ohmite	3	
19							R-51, 53, 54, 57, 60	10K 10% 1/4w Comp. Ohmite	8	
20							R-69, 74, 92			
21										
22							R52	33K 10% 1/4w Comp. Ohmite	1	
23										
24							R55	475 ohm 1% Metal Film Electra MC5F D	1	
25							R56	1.58K " " " " " "	1	
26							R58	150K 10% 1/4w Comp Ohmite	1	
27							R62	470K 10% 1/4w Comp Ohmite	1	
28							R64, 96, 77	1K cermet pot Helipot 62PR1K	3	
29							R65	340 ohm 10% 1/4w comp. Ohmite	1	
30							R66	10meg 10% 1/4w Comp Ohmite	1	
31							R70	220K 10% 1/4w Comp Ohmite	1	
32										
33										

Instrument Flight Research Corporation, Inc., Wichita, Kansas | Dwg. No. IFR-2-409

PARTS LIST: SHEET 4 OF 4 REV:

Line	Size	Assy Brkdown 1	2	3	4	5	Part Number	Description	Quant. per Unit	Cost
1							R-72	27.4K 1% Metal film Electra MC5F D	1	
2							R-75	19.6K " " " " " "	1	
3							R-76, 97	1K 10% 1/4w comp. Ohmite	1	
4							R-79	56K 10% 1/4w comp. Ohmite	1	
5							R-80	40.2K 1% Metal Film Electra MC5F D	1	
6							R-81, 82	2.21K " " " " "	2	
7							R-84	5.6K 10% 1/4w comp. Ohmite	1	
8							R-86	3.9K 10% 1/4w comp. Ohmite	1	
9							R-89	4.7K 10% 1/4w comp. Ohmite	1	
10							R-91	68 ohm 10% 1/4w comp. ohmite	1	
11							R-93	270 ohm 10% 1/4w comp. Ohmite	1	
12							R-95	1.8K 10% 1/4w comp. Ohmite	1	
13							R-98	51 ohm 5% 1/4w comp. Ohmite	1	
14										
15										
16										
17							CR-1 through CR-28	1N625 or GE DHD 674	28	
18										
19							CR-29, 30	Fairchild FD 333	2	
20										
21							CR-31, 32, 33, 34	1N4002 or equiv.	4	
22										
23							CR-35	1N4735 or equiv.	1	
24										
25							CR-36	1N457 or equiv.	1	
26										
27							CR-37	Hot carrier diode Solitron MSD 324	1	
28										
29							CR-38	1N277	1	
30										
31							Y-1	75 mc crystal series mode HC-6 ±0.005%	1	
32										
33										

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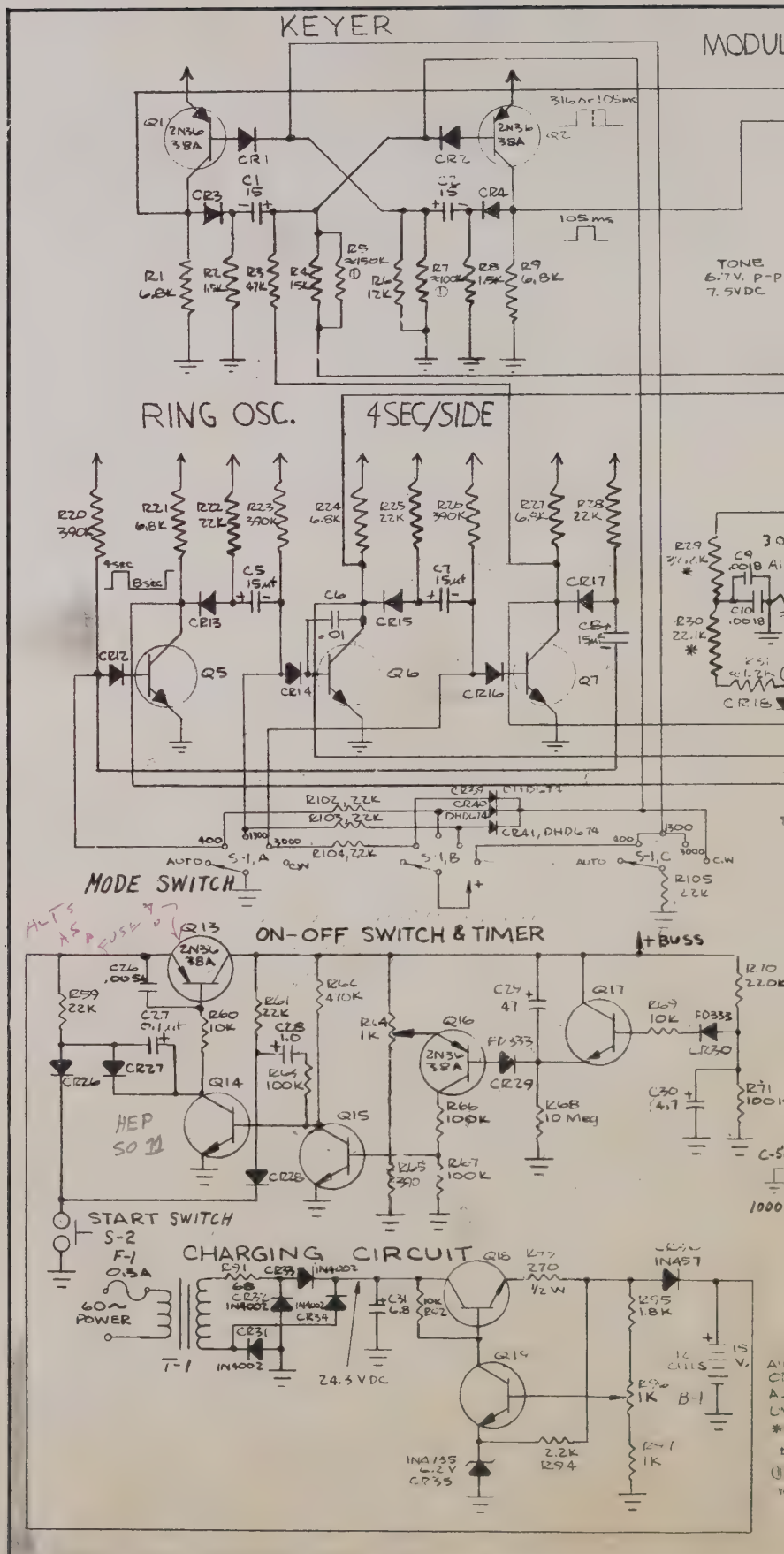
KEYER
MODUL
RING OSC.
4SEC/SIDE
TONE
MODE SWITCH
ON-OFF SWITCH & TIMER
START SWITCH
CHARGING CIRCUIT
+BUSS
60~ POWER
24.3 VDC
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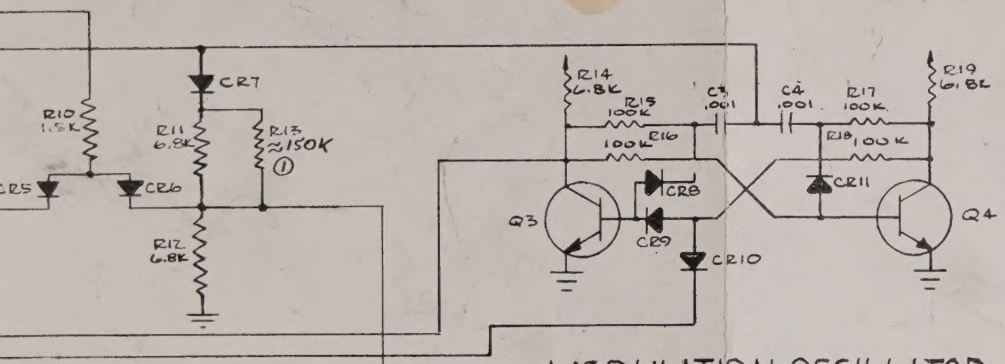
SO 11

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

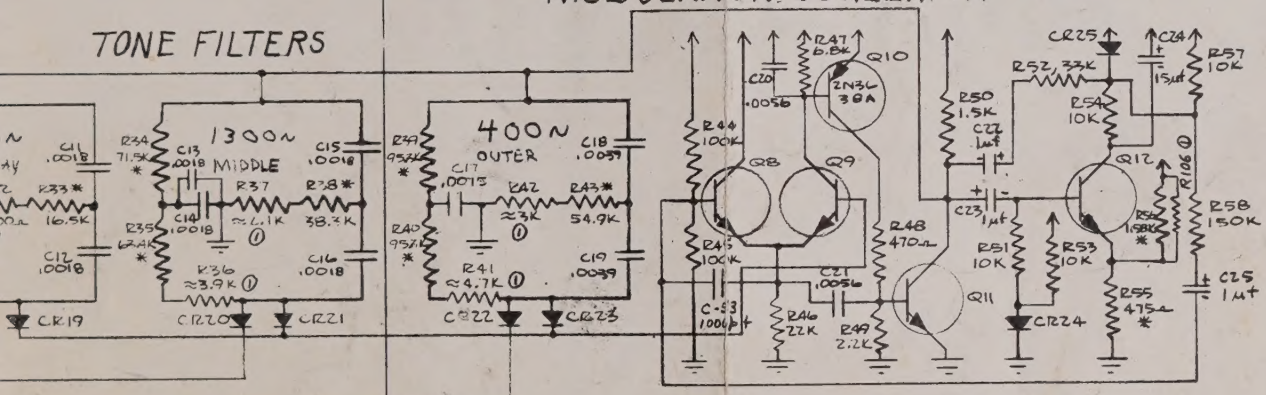
ATION SWITCH

KEYING ALTERNATOR



MODULATION OSCILLATOR

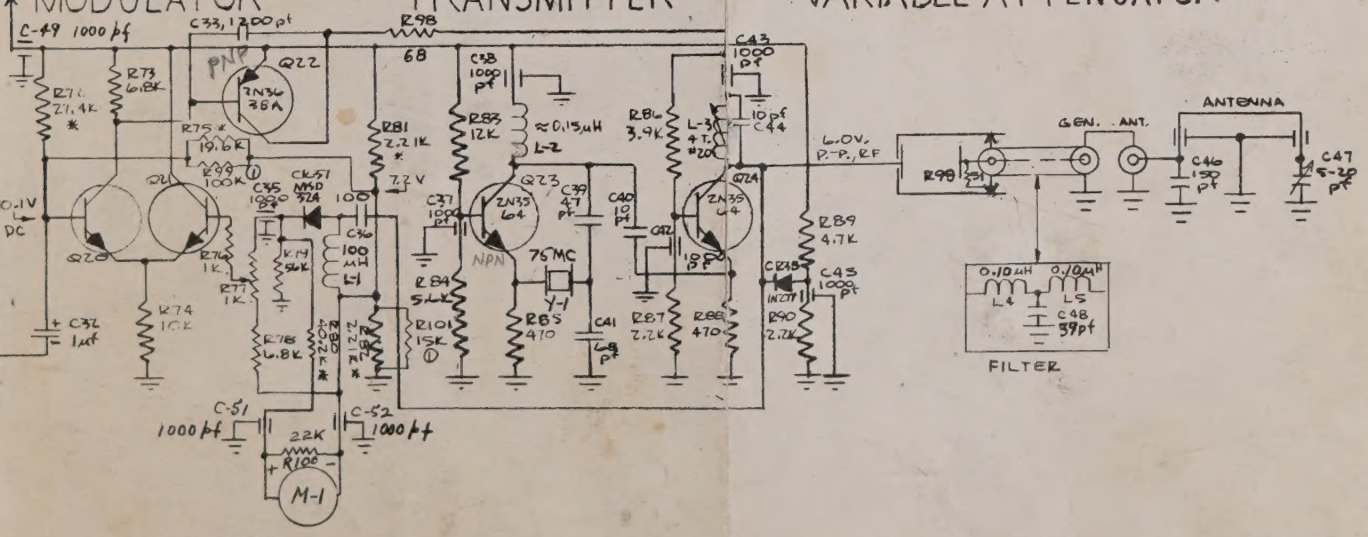
TONE FILTERS



MODULATOR

TRANSMITTER

VARIABLE ATTENUATOR



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LTAGES MEASURED WITH 15V. A+.

TOLERANCES (EXCEPT AS NOTED)			
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			APPROVED BY
FRACTIONAL ±	TITLE MARKER TESTER		
ANGULAR ±	DATE 5-10-56	DRAWING NUMBER IFR-2-279A	

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